

## Specific quality criteria for research papers on adults learning mathematics?

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### Abstract

Since 1997, the identity of the research field of adults learning mathematics has been debated; the research field has grown in quantity and quality; and the research forum Adults Learning Mathematics (ALM) has established an international journal. In practice, the researchers answer the question about identity and quality of research papers in committees, in editorial teams or as referees in journals. The purpose of this article is to create a starting point for a debate, based on quality criteria in the field of mathematics education research, on specific criteria to locate quality of research papers on practice-related educational research in the field of adults learning mathematics. Following general criteria in mathematics education any research paper has to explain and present its own *problematique* explicitly i.e. define the problem field and the theoretical/methodological/philosophical approach of the study reported. Additional criteria specific to the field of adults learning mathematics are suggested, namely, the author should position themselves by answering the following three questions: (1) What is adult mathematical knowledge (or adult numeracy)? (2) How do adults learn mathematics? (3) Why teach mathematics to adults?

Keywords: research papers, quality criteria, identity, adults learning mathematics

### A search for identity and quality

For the last 15 years a new international research field has been cultivated in the borderland between mathematics education and adult education. Conceptual frameworks and theoretical approaches are imported from the two neighbouring fields and restructured within the new community of practice and research (Wedege, 2001). The international research forum Adults Learning Mathematics (ALM) was created in 1994 and need was felt for an identity debate within this new research area. Thus, the following question was formulated at the Fourth International Conference on Adults Learning Mathematics, ALM4, in 1997: "Could there be a specific *problematique* for research in adult mathematics education?" (Wedege, 1998). The debate continued at the following conferences and it was reported in the proceedings (e.g. Wedege, Benn & Maasz, 1999). Coben (2000) presented the identity debate in the introduction, "Perspectives on research on adults learning mathematics", of the first international anthology from the field, and FitzSimons, Coben and O'Donoghue (2003) examined the current state of research in adult mathematics in the chapter "Lifelong mathematics education" of the Second International Handbook on Mathematics Education. In a review of research on adult numeracy, Coben (2003) also presented the debate on adult mathematics education as a research domain.

In this debate, the focus is on common characteristics in the construction of the area of investigation (adult numeracy and mathematics) and in the need for multi- and inter-disciplinary inquiry (pedagogy, psychology, sociology, anthropology etc.). Mertens (2005) presents the *paradigm* in educational research as "a way of looking at the world [...] composed of certain

philosophical assumptions that guide and direct thinking and action" (p. 7). According to her analysis, the central issues in a debate on identity of a specific "paradigm" in education research are ontological, epistemological and methodological. Where ontological issues deal with the nature of reality, epistemological issues with the nature of knowledge and with the relation between knower and would-be-known, and methodological issues deal with the approach to systematic enquiry. This notion of paradigm is consistent with an epistemological framework which I construed and called the concept of *problematique* in mathematics education with inspiration in French epistemology. *Problematique* covers a systematically linked problem – and practice – field within mathematics education research. Researchers working within a given *problematique* have a specific theoretical and/or methodological approach to the subject area (e.g. adults learning mathematics), and their approach is defined by ontological, epistemological and methodological choices (see Wedege, 1998, 2001, 2006). In the following section, I shall further present the terminology of *problematique*.

Within the research field of adult mathematics education, we may find different *problematiques*. Even incommensurable *problematiques* occur, like the one found in the International Adult Literacy Survey (OECD, 1995) – presuming that it is meaningful to measure people's quantitative literacy with the same tool across different countries and cultures – versus investigations from an ethnomathematical perspective, which emphasizes the local and the culturally specific (Rogoff, 1984). In both cases, the subject area is people's mathematical everyday competences, but the subject field is construed differently because of different research interests and questions, theories and methodologies. However, I have claimed that the *problematiques* represented within the international research forum of ALM have a series of common and specific traits. Among these are the following three characteristics (Wedege, 2001).

1. *Subject area: The learner is in focus, and their "numeracy" is understood as mathematical knowledge.*

Adult numeracy is the main construct in the subject field. In English speaking countries, the term "numeracy" is used for certain basic skills and understandings in mathematics which people need in various situations in their daily life. Numeracy is a key word in basic adult mathematics education. As a concept, however, numeracy is deeply contested in politics, education and research. Nevertheless, as an analytical concept, adult numeracy may be considered as mathematical activity in its cultural and historical context. For a review of international research and related literature on adult numeracy, see Coben (2003).

2. *Two approaches: The duality between the objective and subjective perspective is implicit, or explicit, in all studies.*

Two different lines of approach are possible and intertwined in the research: *the objective approach*, starting either with societal and labour market requirements with regard to adults' mathematics-containing competences or with demands from the academic discipline (transformed into "school mathematics"), versus *the subjective approach* starting with adults' need for mathematics-containing competences and their beliefs and attitudes towards mathematics (Wedege, 2001).

3. *Justification: The general aim of education and of research is "empowerment" of adults learning mathematics.*

This statement was concluded in the debate of "Adults Learning Mathematics as a community of practice and research" (Wedege, Benn & Maasz, 1999). Later Johansen

(2006) has drawn the same conclusion based on her study of the justification problem from a discourse analytical perspective.

At the Thirteenth International Conference of Adults Learning Mathematics, in 2006, I formulated this question: “Could there be specific criteria for quality of research papers in the field of adults learning mathematics?” It was obvious for me that this debate was needed as a next step in the search for identity. And indeed, at the conference the quality debate was welcomed by the participants. My purpose was to create a starting point for a debate on specific quality criteria within our field on the basis of general criteria for educational research and more specific criteria in the field of mathematics education.

### **Problematiques in mathematics education**

In educational sciences and mathematics education research literature dealing with general issues of identity and quality, the term “paradigm” is used often with a broad meaning like in Mertens (2005), Furlong and Oancea (2005) and Dörfler (1993). According to Dörfler (1993), there exist different, even mutual exclusive paradigms, in the community of classical research in mathematics education. One of them for instance is the strong orientation to mathematical content, another is the social-constructivist paradigm. However, in mathematics education, the term “paradigm” has also been connected with Kuhn’s concept of paradigm defined as a system of common interests and presumptions characterising “normal science” in a specific historical period, a so-called “disciplinary matrix” (Kuhn, 1962). In this sense it is used to state that mathematics education research is weak in paradigms (see, for example, Niss, 2007). However, paradigms in the sense that Kuhn used them in sciences (mainly physics) do not exist in humanities or social sciences where several competing and incommensurable theories legitimately exist side by side at any time.

Like paradigm, the French term “*problématique*” is also used in a broad sense e.g. in Dörfler (1993) and in Sierpinska and Kilpatrick (1998). I have argued that the meaning of “*problématique*” in mathematics education is “problem field within which the coherence is defined by a science (psychology, sociology, anthropology etc.) and/or a theory” (Wedege, 2006, p. 321). In order to reconnoitre the complex scientific landscape of the borderland between mathematics education and adult education, I have used an epistemological terminology with the key terms: subject area, subject field, problem field and *problématique* as analytical tools (Wedege, 1998, 2001, 2006).

In any research process the *subject area* (the area to be investigated), is decided upon and a simple structure is formulated. Subjects within the area of adults learning mathematics might be, for example, the following phenomena:

- mathematics in adult vocational training;
- basic mathematics in the Brazilian adult education;
- adults’ views of mathematics; or
- learning mathematics as part of lifelong learning.

Taking the point of departure in a specific position, the researcher then adopts a certain view of the subject and identifies a *problem field* concerning the subject area by formulating problem complexes. In this way, the subject area is further structured into a *subject field*, the field which is actually investigated. Problem complexes might be, for example:

- the tension between the constraints and the needs felt by adults to learn mathematics;
- the neglect of developing adults’ statistical literacy in adult education; or
- the identification of adults’ mathematical understandings with common sense.

Within the community of ALM and other communities of research, problem complexes are formulated in the form of research questions and answers about the subject field on the basis of a specific theoretical and/or methodological approach, and a systematically linked problem field a

*problematique* is constructed. The subject field is opened and closed at the same time during this process. New questions, which could not be posed before the conceptualization, are formulated and as the complexity of the problem field is reduced other questions cannot be formulated. For example, questions concerning possible contributions from mathematics education to the development of adults' technological competences in the workplace presume a technology concept (Wedege, 2000). The Danish proverb, "Som man råber i skoven får man svar" (generally translated to: "You get what you're asking for") represents one of the basic ideas in this concept of *problematique*. Another epistemological presumption is that problems formulated as research questions are the driving force of the research (Bachelard, 1949).

### **Why do we need quality criteria?**

The existence of criteria, no matter how provisional or incomplete, allows researchers to assess the quality of their work or the work of others, and it allows the field to see what progress, if any, is being made. [...] the criteria are lenses through which the research landscape can be viewed. (Kilpatrick, 1993, p. 31)

Any scientific discipline has its specific quality criteria. Hence, quality was naturally one of the dimensions to be debated in the search for identity of mathematics education as a research domain, at the ICMI study conference in 1994 (Sierpinska & Kilpatrick, 1998). The question discussed in the working group was: "What criteria should be used to evaluate the results of research in mathematics education?" The result of the discussion was a framework for examining criteria for the quality of research in mathematics education, and a series of questions for continuing the debate was formulated. One question was, "Could the relation of mathematics education to classroom practice generate criteria for quality in research in mathematics education?" Three of the papers presented at the conference dealt with quality (Hanna, 1998; Hart, 1998; Lester & Lambdin, 1998).

The issue of quality has not been on the agenda explicitly during the ALM conference sessions. In practice, the researchers answer the question about identity and quality of research papers in committees, in editorial teams or as referees in journals. According to the former chief editor, FitzSimons (2006) of *Adults Learning Mathematics – an International Journal* (ALMJ), the "refereed electronic journal has now been established to further develop the high quality work in this field" (p. 246). She presented and discussed the technical and conceptual requirements for the preparation of articles for the refereed journal, at the ALM12 conference in 2005. Instead of the timid question "could there be specific criteria for quality in the field of adults learning mathematics" the question might be formulated as: "What are the specific criteria ...?"

### **Structuring and restricting the debate**

As the issue of this article is specific quality criteria for research papers in the field of ALM, I have to clarify the meaning of the two terms "research" and "specific".

In clarifying research I follow Zan (2004) in her conception of *research* as "disciplined inquiry", meaning that in order to be "research" a study in mathematics education has to possess some characteristics, for example that:

- the study must be intentional enquiry, aimed to face a specific problem;
- the study must be connected with theory;
- the study must be connected with mathematics educational practice;
- the study must be public and verifiable; and

- the research procedures ought to be checkable.

This tentative answer to the question “What is research?” leads to the question “What is good research?”. Zan (2004) has proposed a list of quality criteria: objectivity, validity, generality, relevance, utility, ethics, originality, replicability etc. But a central point in her paper is that there is no agreement among researchers about these criteria and that the researchers’ epistemological choices play an important role in the choice of quality criteria.

In clarifying “specific” we need to consider – specific in relation to what? In my work, I lean on the debate within educational research and within mathematics education. As mentioned above, any scientific discipline has its own quality criteria. There exist general criteria for educational sciences. There are quality criteria specific to mathematics education. Furthermore, there are criteria for specific forms of theoretical and empirical research in education, for example fundamental research and action research. In order to assess quality in applied and practice-based educational research, Furlong and Oancea (2005) propose four dimensions and sub-dimensions of quality as presented in Table 1. I have chosen this example to illustrate the complexity of the quality debate in educational sciences, which also encompasses economic, technological and political issues.

Table 1. Dimensions of quality in applied and practice-based educational research (Furlong and Oancea, 2005, p. 15)

<i>Epistemic:</i> Methodological and theoretical robustness	<i>Technological</i>	<i>Capacity development and value for people</i>	<i>Economic</i>
Trustworthiness	Purposivity	Plausibility	Marketability and competitiveness
Builds on what is known + contribution to knowledge	Salience/ timeliness	Partnership, collaboration and engagement	Cost-effectiveness
Explicitness	Specificity and accessibility	Reflexivity, deliberation and criticism	Auditability
Propriety	Concern for enabling impact	Receptiveness	Feasibility
Paradigm-dependent criteria	Flexibility and operationalisability	Transformation and personal growth	Originality
<i>Scientific robustness</i>	<i>Social &amp; economic robustness</i>		

The four dimensions of quality, in the analysis of Furlong and Oancea (2005), are the epistemic dimension, the technological dimension, the capacity development dimension and the economic dimension. In this paper, I restrict the discussion to epistemic questions concerning “methodological and theoretical robustness”. The five sub-dimensions of the epistemic dimension are trustworthiness; builds on what is known plus contribution to knowledge; explicitness; propriety; and paradigm dependent criteria. By *paradigm* they mean “a complex of epistemological/philosophical and methodological traditions, shared practices etc. used within a particular “epistemic community” (Furlong & Oancea, 2005, p.12), and they state that criteria may well vary depending on the particular paradigm used. With this broad meaning of the term “paradigm” – also compatible with the concept of *problematique* – I claim with reference to my analysis of the field (Wedege, 2001) that the core of the international research on adults learning

mathematics is dominated by a specific paradigm – or type of *problematique* – and thus are to be evaluated by similar quality criteria.

### **Research versus report**

When a referee comments on a research paper it is always necessary to assess both the research behind the paper AND the paper as a research report. The research being satisfactory is a necessary but not sufficient condition for a research report to be accepted. In terms of the report, there are particular criteria, e.g. location and discussion of the author's contribution to the research field and epistemological and methodological consciousness and reflection that need to be considered. Such criteria concern the quality of the conducted research. In order to structure the quality debate I suggest to distinguish analytically between:

- quality of the conducted research; and
- quality of the paper as a report of the research and its results.

In the literature on quality in mathematics education, we find this distinction in that some of the articles concern the research (Hart, 1997; Kilpatrick, 1993; Vital & Valero, 2003; Zan, 2004), some the research papers (reports or dissertations) (Dörfler, 1993; Hanna, 1998, FitzSimons, 2006) and some both (Lester & Lambdin, 1998).

The focus of this article is the report – not the conducted research – and I shall reduce the complexity of the quality debate further. The research field of ALM is situated in the borderland between mathematics and adult education (Wedge, 2001) and as such it is opened and closed by the two large fields. However, in my discussion, I further restrict the problem of quality criteria in two ways: (a) I look at research papers through quality criteria formulated within mathematics education research, and (b) I look for criteria for papers dealing with practice-related educational research – meaning that the research behind the report addresses a specific problem in the practice of adult mathematics education and not an epistemological, methodological or a purely theoretical problem.

### **General quality criteria for research papers in mathematics education**

At a symposium in Denmark on criteria for scientific quality and relevance in the didactics of mathematics, Dörfler (1993), former editor of *Journal für Matematikdidaktik* and of *Educational Studies in Mathematics*, presented a list of requirements or demands, which he used to obtain a rather formal assessment of a research paper. By virtue of Dörfler's position in the field, these criteria might be considered as representing the first step towards what I seek: a checklist for any author of scientific articles in mathematics education. Here follows my summary of the list:

1. There should be an explicitly formulated rationale for the presented research: What are the goals? What is the motivation? The central research questions?
2. The research paradigm, the background philosophy should be made explicit and recognizable.
3. The employed research method and research design must be clearly stated and described -- especially when it is about empirical research.
4. In the case of theoretical papers or sections, assertions, statements and theses must be argued and made plausible within the assumed premises and framework.
5. In empirical research a clear and orderly presentation of the results is essential and the results must be strictly separated from their interpretation.

6. A general requirement is for a reasonable embeddedness in existing research and literature. Research is a social process and this should be reflected in every single paper to a certain extent.
7. The author must make plausible to the reader the relevance of the research to mathematics education. Not that the results could necessarily be applied in the classroom the next day, but in some way the paper should be concerned with teaching/learning mathematics.
8. Almost trivial are requirements like: clear and well structured, well defined or explicated terms and concepts, relatedness of the various parts of a paper, systematic referencing etc. (from Dörfler, 1993, pp. 85-87).

These criteria are relevant to all kind of mathematics education research, not only practice related research. However, all the points 1-8 concern the epistemic dimension of Table 1, and only one of the requirements (7), is specific to mathematics teaching and learning. But the criteria have been developed and formulated in the practice of two prominent journals in mathematics education research and, according to Dörfler (1993), “the specificity of mathematics education research derives from the range of human experience it studies and organizes” (p.79).

In (1) Dörfler claims the importance of making the research interest and questions visible, and in (2) he talks about the “research paradigm” (or “background” philosophy) which also has to be explicit. In (7), he states that the problems and the results have to be relevant to mathematics education. The three central criteria together are consistent with the concept of *problematique* where the meaning of the problem in mathematics education is seen as the driving and defining force in research (Wedege, 2001). Thus, it is possible in my work on specific quality criteria in ALM at the same time to use the terminology of *problematique* and to build on the general criteria formulated by Dörfler.

### **Specific quality criteria within the field of adults learning mathematics?**

In FitzSimons's (2006) presentation at ALM12, the question of quality of an article for *Adults Learning Mathematics – an International Journal* (ALMJ) was discussed in general terms; e.g. Does it make an original contribution to mathematics education for adults? And does it provide a well founded and cogently argued analysis?. But she also put forward a specific requirement: “Articles must be relevant to adult mathematics/ numeracy education (...). Here the criteria of relevance is defined in relation to research and theoretical perspectives; to debate; and to practice in the area of adults learning mathematics/ numeracy (FitzSimons, 2006 p. 246). Another specific criterion from the referee report of ALMJ is that the submitted article should clearly be a study in the mathematics education of adults. FitzSimons presents the criterion like this:

... it is important to make the links to adults learning mathematics explicit. One of the problems faced by adult educators, internationally, is the definition of ‘adult’. Accordingly, it may be useful for the author/s to define the kinds of learners for whom the article is intended to be of relevance (e.g., early school leavers, older workers needing retraining, parents wishing to help their children, or new immigrants and others wishing to return to study/employment). Another ongoing debate is over the definition of terms such as ‘mathematics’ versus ‘numeracy’ or ‘mathematical literacy’, and so forth. Authors could briefly clarify their choice of terminology, explaining why they have chosen the particular term/s and what might be included as content or learning outcomes  
 (Op cit p. 247).

In other words, the author must position themselves in the research field of adults learning mathematics. Given that we have a long series of international journals in mathematics

education it is important that any author submitting an article to ALMIJ makes explicit their reasons for this particular choice of journal. At a first glance the journal will publish articles concerned with “all aspects of adult mathematics/numeracy education”. A second glance shows that the conception of adult mathematics education is – and has to be – open to discussion and negotiation.

In the organising team of Topic Study Group 6 (TSG6), *Adult and lifelong mathematics education*, at the 10<sup>th</sup> International Congress on Mathematics Education (ICME) in 2004, we decided the following limitation – and opening – of the subject area of adult mathematics education in our call for papers:

By *adults* we mean people with the identity of citizens, workers, parents, un-employed, engineers etc. The term *lifelong* indicates that education takes place in all facets and spheres of life. By *mathematics* we mean multiple activities and knowledge, including academic mathematics, vocational mathematics, ethnomathematics, folk mathematics and adult numeracy. Regarding *education* we have adopted the terminology of UNESCO (2000) as a point of departure” with a distinction between informal, formal and non-formal education

(from “Aims and focus”, TSG6, ICME-10, 2004).

In TSG6 discussions, the issues were restricted to those following.

- Adult numeracy as a competence, building a bridge between school and personal, civic and working life.
- Adults’ beliefs, attitudes and emotions to mathematics, including their resistance and motivation to learn mathematics.
- The role of technology in adult lifelong mathematics education (informal, formal and non-formal).
- Global aspects, such as the role of large-scale studies of adults’ mathematical “needs”.

And the TSG6 concluded that: “Adult and lifelong mathematics education has multiple dimensions and we have to approach this subject area from psychological, sociological, anthropological, linguistic, philosophical, economic and political perspectives. The studies and experiences are likely to be linked with issues of class, gender and race” (from “Aims and focus”, TSG6, 2004).

Thus, it seems like the specificity of criteria for research papers and articles in ALM so far concerns the definition/limitation of the subject area in the study reported (what are the phenomena being investigated) and the opening of a problem field, for example the bridging of school and every day life, and adults’ resistance to learn mathematics. I propose that the next step in the quality work is a demand for clarification of the *problematique* within which the study is undertaken. The paper should explain and present its own *problematique* -- i.e. answer the following questions:

- What is the problem in the practice of adults learning mathematics and what are the central research questions of the study?
- Why is the problem being investigated – what is the purpose of the study?
- What is the theoretical/philosophical framework of the study?
- What is the methodological approach?

When the author gives an answer to these questions about the background, goals, framework and approach, at the same time he/she should respond to the following three questions, implicitly or explicitly:

1. What is adult mathematical knowledge (numeracy)?
2. How do adults learn mathematics?

### 3. Why teach mathematics to adults?

In this way, the reader will have information about the author's conception of and construction of the subject field (1), about the learning theory behind the study (2), and about the author's answer to the justification problem, which is closely related to the "what" and the "how" questions in mathematics education (3). Like this the author will present her/his position in research based on certain interest and values.

### Provisional conclusion

The purpose of this article is to present and discuss quality criteria for papers dealing with practice-related educational research on adults learning mathematics; i.e. where the underlying research addresses a specific problem in the practice of adult mathematics education and not an epistemological, methodological or a purely theoretical problem. As we have seen, in mathematics education it is a general demand that any research paper should explain and present its own *problematique*, i.e. background, purpose, research questions, theoretical framework and methodology. On this basis, I suggest that the specific quality criteria for papers dealing with practice-related educational research in adults learning mathematics as formulated in the last section, be taken as the conclusion of this paper and, hopefully, the beginning of the further debate in the international research community of adults learning mathematics.

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